Extreme learning machine based prediction of daily dew point temperature

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Abstract
The dew point temperature is a significant element particularly required in various hydrological, climatological and agronomical related researches. This study proposes an extreme learning machine (ELM)-based model for prediction of daily dew point temperature. As case studies, daily averaged measured weather data collected for two Iranian stations of Bandar Abbas and Tabass, which enjoy different climate conditions, were used. The merit of the ELM model is evaluated against support vector machine (SVM) and artificial neural network (ANN) techniques. The findings from this research work demonstrate that the proposed ELM model enjoys much greater prediction capability than the SVM and ANN models so that it is capable of predicting daily dew point temperature with very favorable accuracy. For Tabass station, the mean absolute bias error (MABE), root mean square error (RMSE) and correlation coefficient (R) achieved for the ELM model are 0.3240 °C, 0.5662 °C and 0.9933, respectively, while for the SVM model the values are 0.7561 °C, 1.0086 °C and 0.9784, respectively and for the ANN model are 1.3205 °C, 1.2589 °C and 0.9663, respectively. For Bandar Abbas station, the MABE, RMSE and R for the ELM model are 0.5203 °C, 0.6709 °C and 0.9877, respectively whereas for the SVM model the values are 1.0413 °C, 1.2105 °C and 0.9733, and for the ANN model are 1.3205 °C, 1.5530 °C and 0.9617, respectively. The study results convincingly advocate that ELM can be employed as an efficient method to predict daily dew point temperature with much higher precision than the SVM and ANN techniques.

Keywords:
Dew point temperature
Extreme learning machine (ELM)
Prediction

1. Introduction
The dew point temperature represents the temperature at which water vapor in the air condenses into liquid water. The availability of accurate and reliable dew point temperature data plays a notable role in various hydrological, climatological and agronomical related researches (Lawrence, 2005; Emmel et al., 2010; Millán et al., 2010; Katul et al., 2012; Lekouch et al., 2012; Feld et al., 2013) where it has been concluded that dew point temperature is gradually increasing over time and can be considered as a significant climatic parameter for research on the long-term climate change. In fact, the dew point temperature data is really significant to identify whether or not it will rain or snow and how much risk there is for a grass or brush fire within a dry spell. In several hydrological, climatological and agronomical models, the dew point temperature is required as an important input parameter for estimation of evaporation and evapotranspiration (Hubbard et al., 2003). Dew point temperature is typically utilized along with relative humidity to identify the moisture level of the air (Lawrence, 2005). It can also be used in conjunction with wet bulb-temperature for computing the ambient temperature, which provides the possibility for being prepared against potential frosts which may harm crops (Snyder and Melo-Abreu, 2005; Drezner, 2007; Shank et al., 2008). Dew point temperature can also be used to provide a favorable estimate of the near-surface humidity that influences the stomatal closure in plants where a low level humidity may result in declining plant productivity (Kimball et al., 1997; Shank et al., 2008). The dew would be really significant for plant...